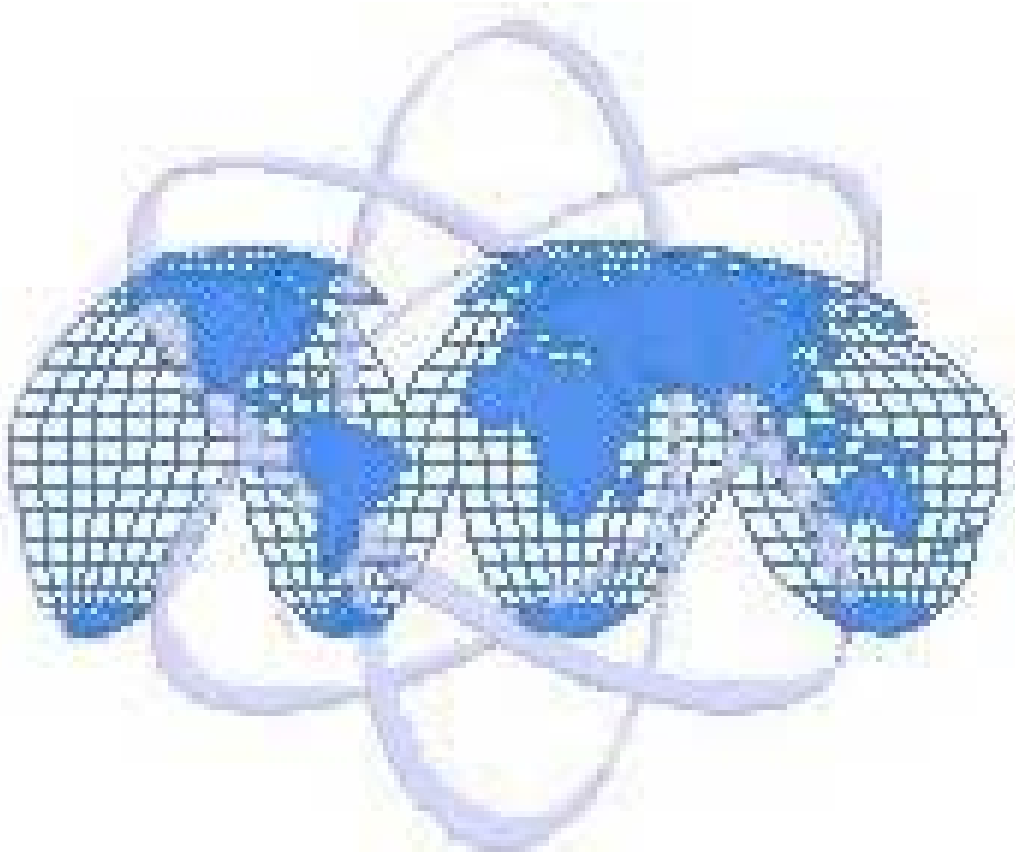


**Ron Lehman**  
**Saclay Wrap Up**

**The 2003 Futures Project of  
the Center for Global Security Research  
Lawrence Livermore National Laboratory**



**“ATOMS FOR  
PEACE”  
AFTER FIFTY  
YEARS:  
The New  
Challenges and  
Opportunities**





The Big Question:

**WHERE  
ARE  
THINGS  
NUCLEAR  
HEADED  
NOW?**

**And Who Cares?  
ie, the Audience?**

The bumper stickers?

The one-liners?

The 3 x 5 Card?

The elevator speeches?

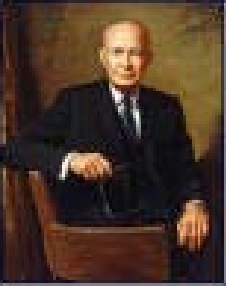
The one-pagers?

The executive summary?

The dissertations?

**AfP50/50**





**ATOMS FOR PEACE  
AFTER FIFTY YEARS:  
The New Challenges  
And  
Opportunities**



# **Can we understand and integrate these?**

## **➤ INTERNATIONAL SECURITY**

➤ **Defense**

➤ **Proliferation**

## **➤ CIVILIAN APPLICATIONS**

➤ **Power**

➤ **Medical and other Peaceful Applications**

## **➤ CROSS-CUTTING ISSUES**

➤ **Materials and Waste**

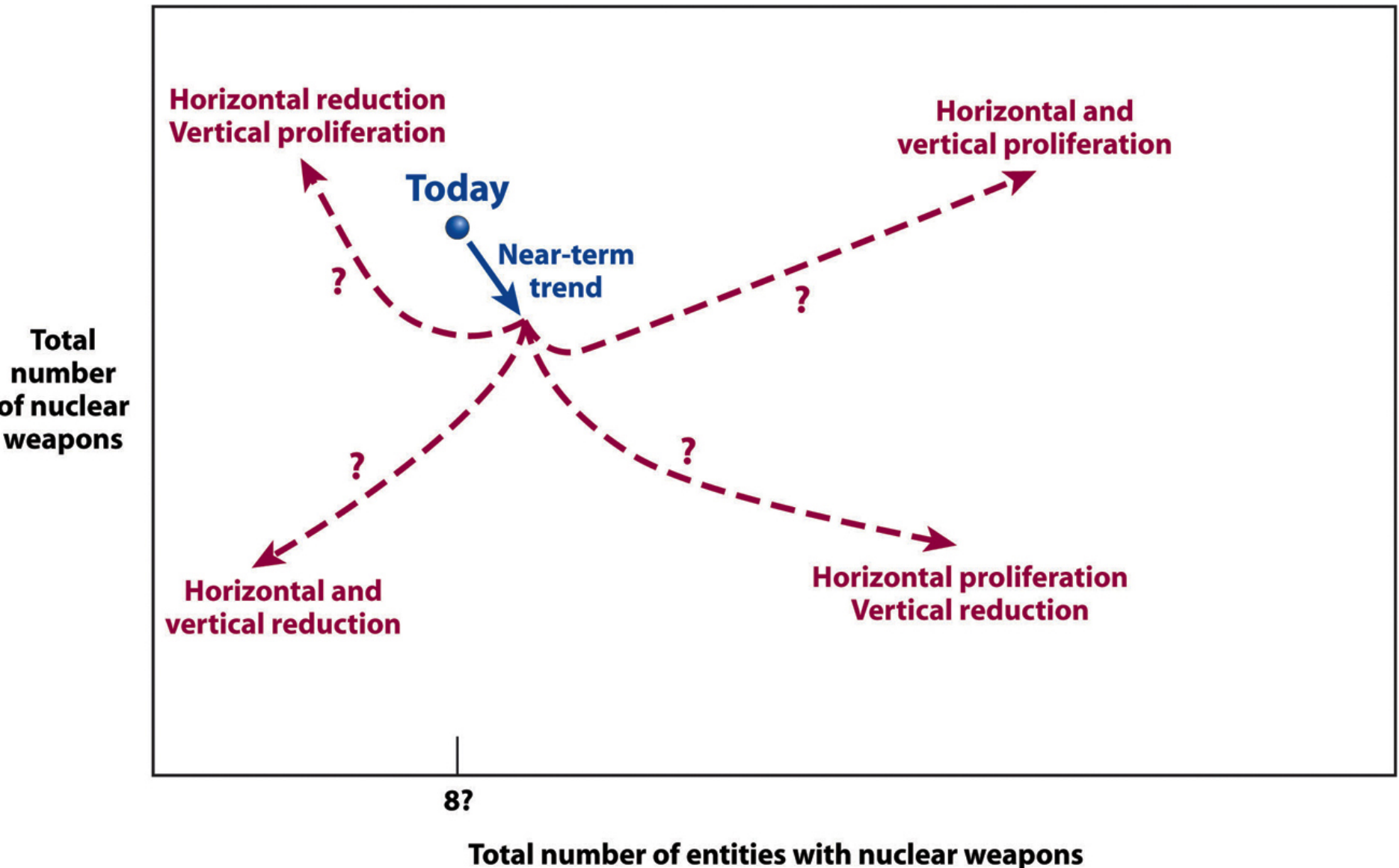
➤ **Governance**

➤ **Evaluating and Communicating**

**Benefits and Risk**

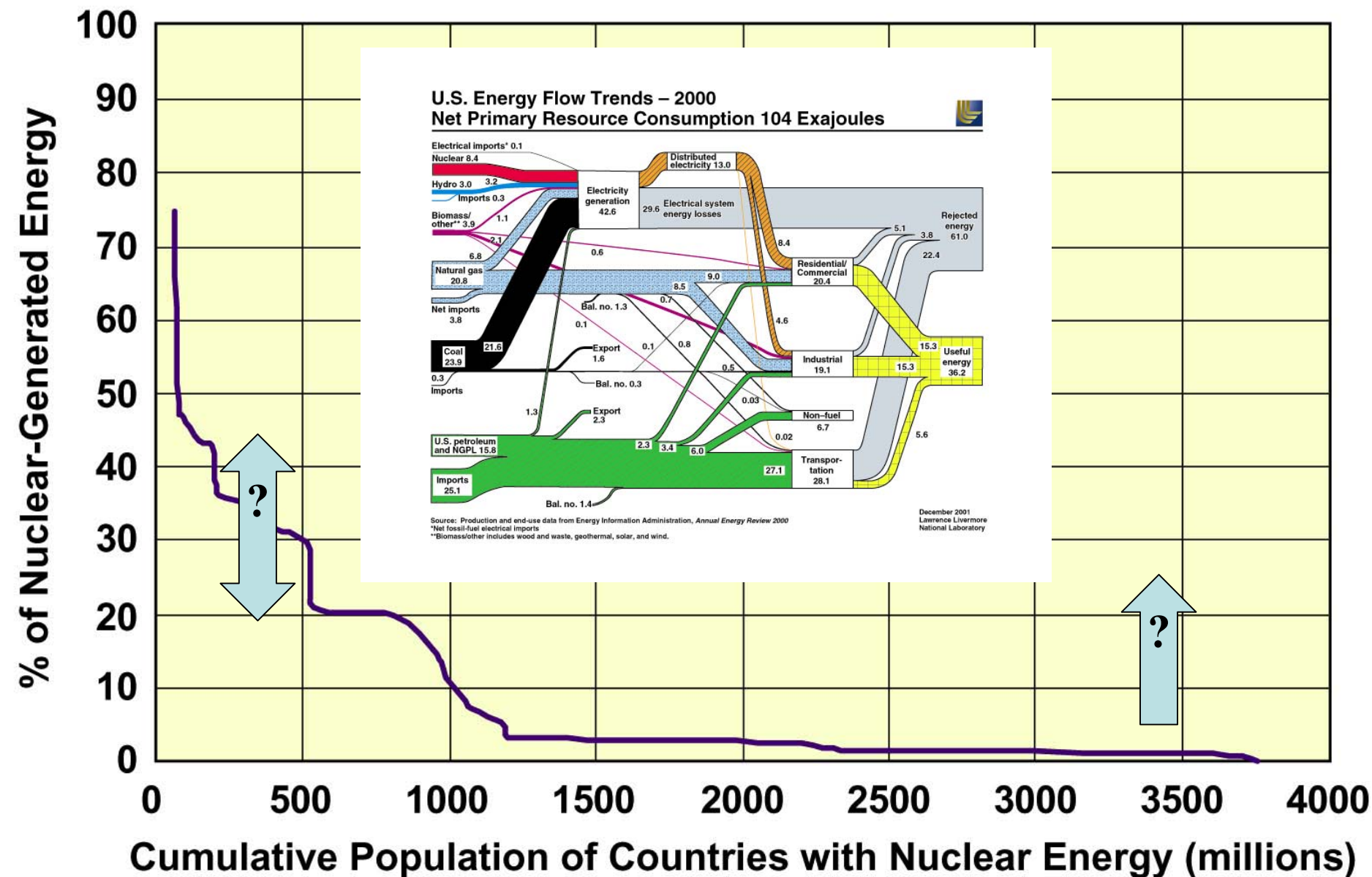


# Where are Nuclear Forces and Proliferation Headed?



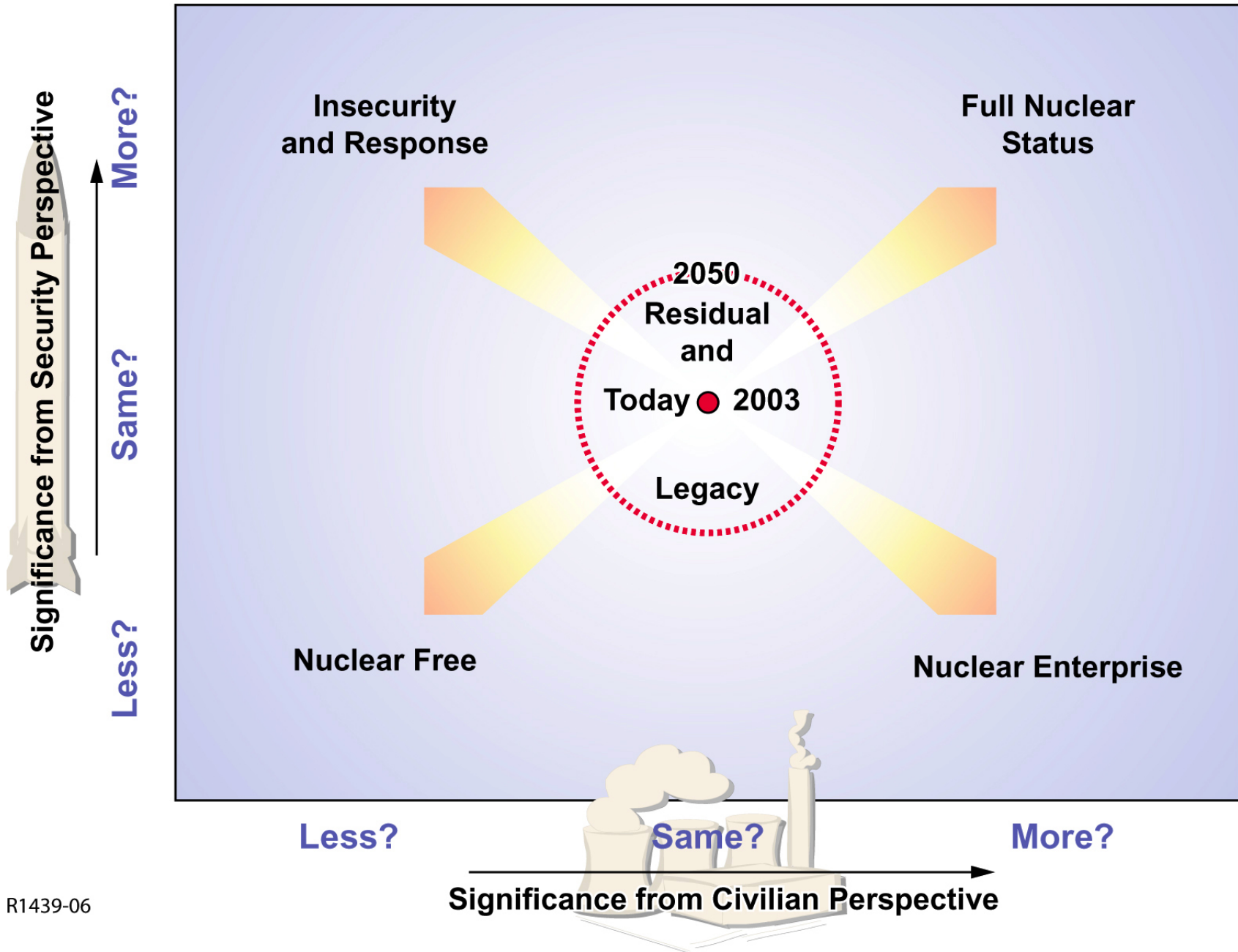


# Will the Intensity and Quantity Increase or Decrease?





# Alternative Nuclear Futures







## **Perspectives:**

**Analytical: What Could Happen?**

**Probabilistic: What Will Likely Happen?**

**Predictive: What Will Happen?**

**Normative: What Should Happen?**

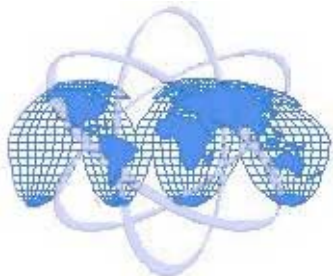
## **Insights:**

**Fundamental Forces (Agreed)?**

**Significant Uncertainties (Not Agreed)?**

**Transforming Events (May not Control)?**

**Leveraged Factors for Change (Might Control)?**



**Measures of Merit/Indicators of Success?**



# NPT, BWC, CWC:

Of 194 States, 190 party to at least one (98%):

189 party to NPT (97%); 147 sign all (76%);

119 party to all (61%); only 4 party to none.

Neither  
party nor  
signatory to

Party or  
signatory to

Party to

CWC	20 [8]*	174	147
BWC	30 [12]*	164	146
NPT	5 [3]*	189	189

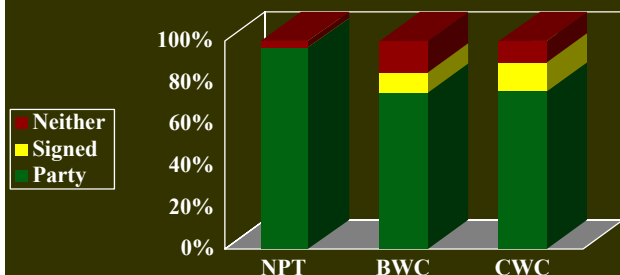
Not  
party or  
signatory to

Party or  
signatory to

Party to

total of Three Treaties	45 [21]* <i>i.e. signed 2 or less</i>	147 <i>i.e. signed 3</i>	119
at least Two Treaties	11 [2]* <i>i.e. signed 1 or 0</i>	183	168
at least One Treaty	1 [0]* <i>i.e. signed 0</i>	193	191

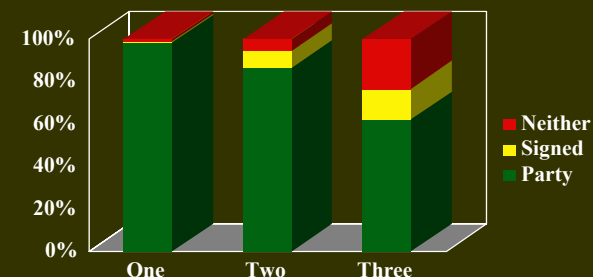
Parties by Treaty



\*[had more than  
1 M pop &  
\$1.5 B GN in 1993]

Ron Lehman  
26 Jul 2003

Parties to Some or All 3 Treaties

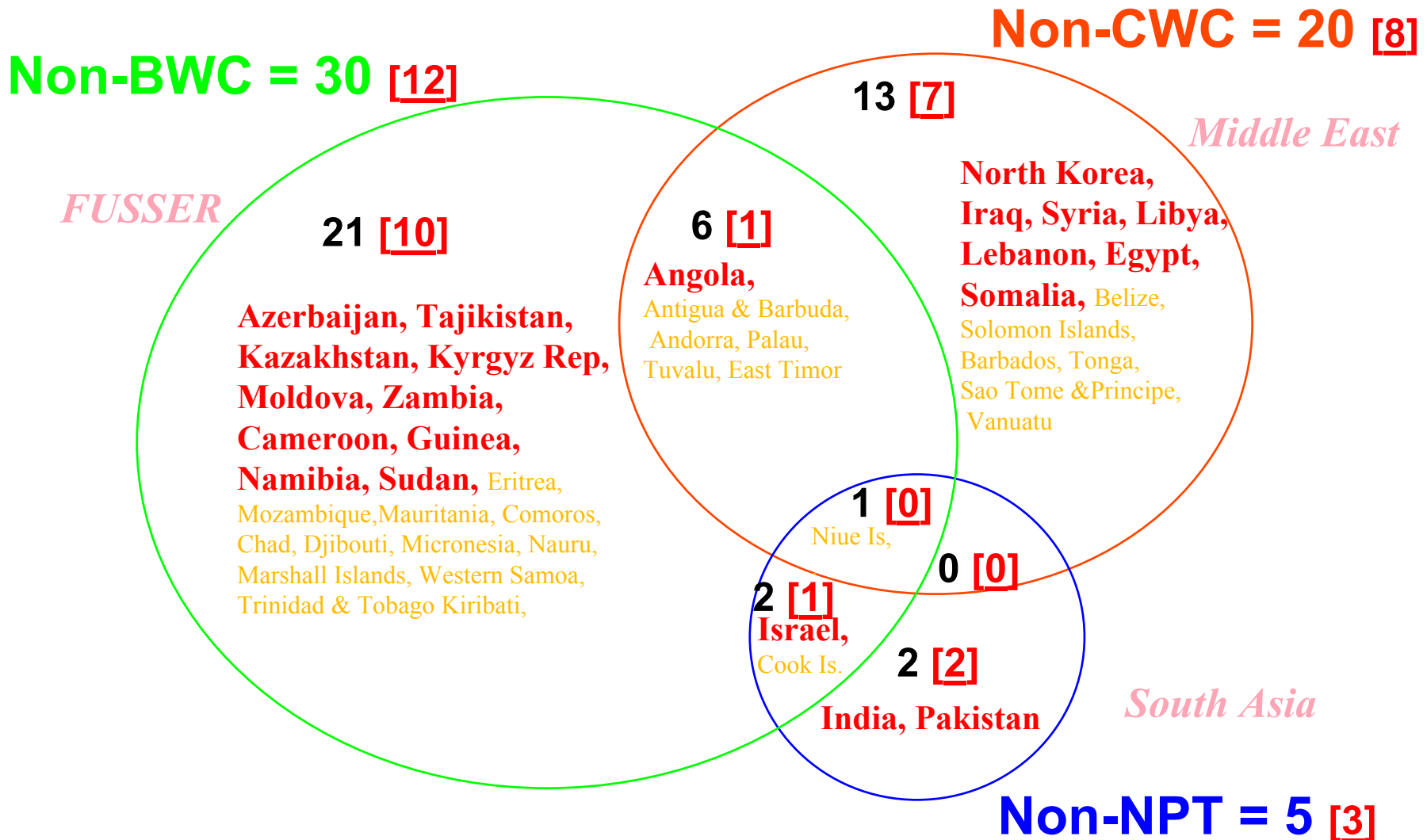




# 45 Nations Currently Neither Party Nor Signatory to one or more of NBC NP Regimes (24% of 194)

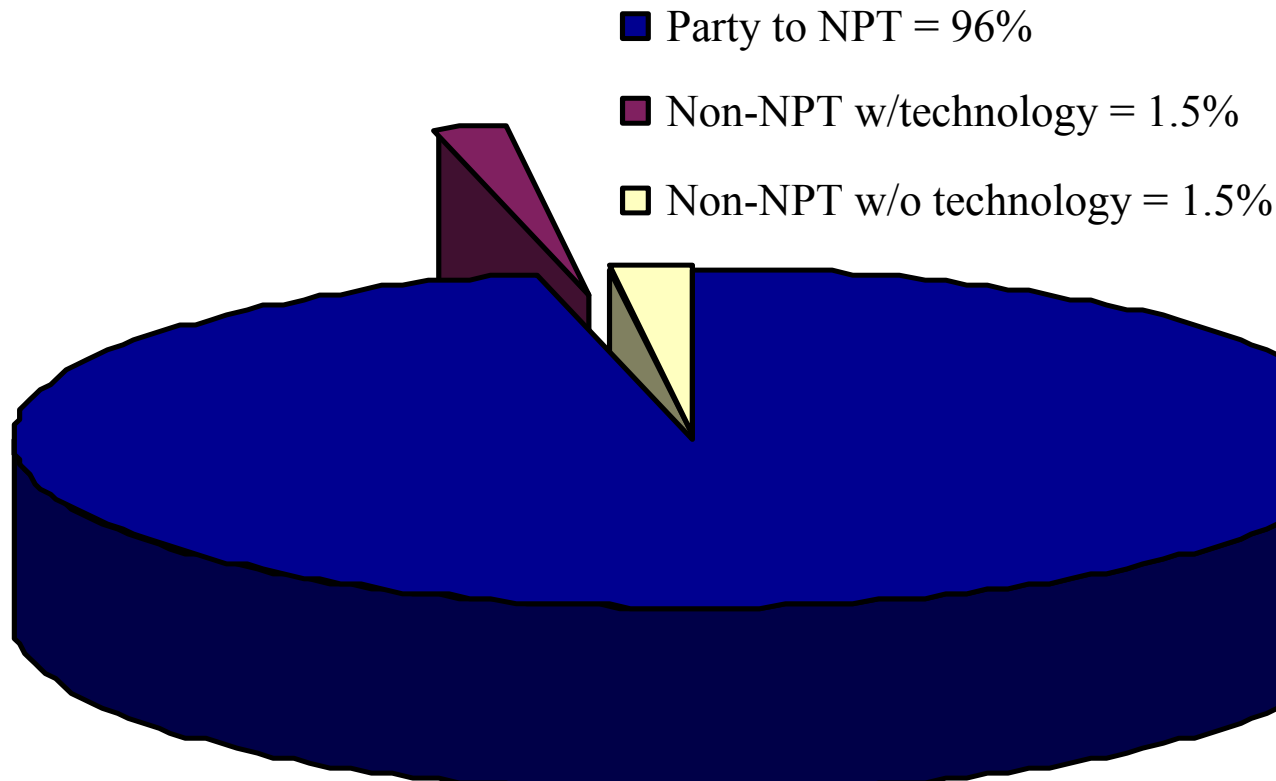


[21 are states w/ 1M pop & \$1.5 B GNP in 1993]





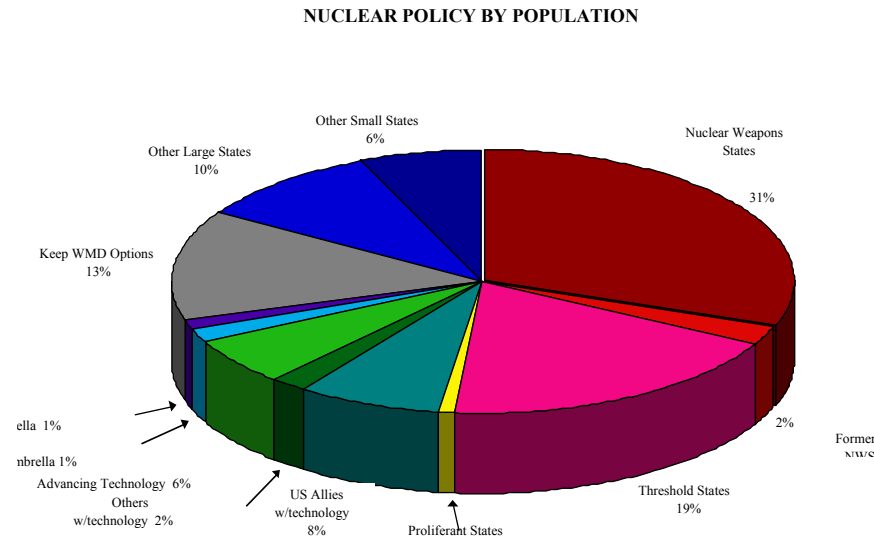
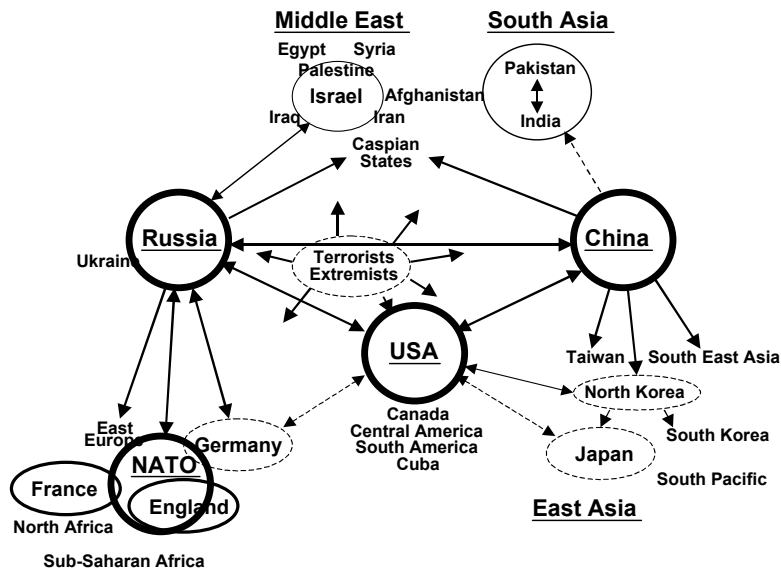
# Only Three Nations with significant nuclear capability are not parties to the NPT



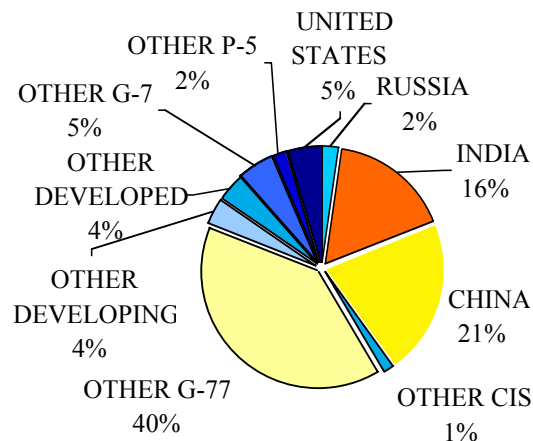


# Security Context

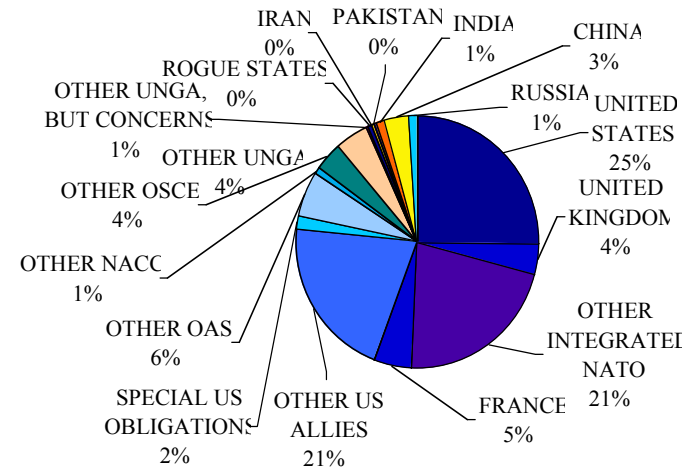
## Global relationships of regional nuclear threat clusters



### SECURITY FORA BY ECON GROUPS BY POPULATION, 1998



PATTERNS BASED UPON US  
SECURITY ASSURANCE POLICY,  
BY GNP, 1996





# Of 76 States with Reactor or Delivery System, 35 have some Nuclear Weapons History, perhaps 13 Obtained Nuclear Weapons, and 9 may Have Weapons Today

## Obtained = 13?

Have ( 9?)

NPT = 5

**US**

**Russia**

**UK**

**France**

**China**

Declared = 2

**India**

**Pakistan**

Achieved = 2?

**Israel?**

**DPRK?**

Achieved, then Reversed = 1

**South Africa**

Inherited, then Reversed = 3

**Belarus**

**Kazakhstan**

**Ukraine**

## Concern = 5?

**Iran?**

**Algeria?**

**Syria?**

**Saudi Arabia?**

**Libya?**

## Other History = 17

***Iraq***

**Sweden**

**Switzerland**

**South Korea**

***Taiwan***

**Argentina**

**Brazil**

**Egypt**

***Serbia & Montenegro***

**Romania**

**Canada**

**Australia**

**Germany**

**Japan**

**Italy**

**Indonesia**

***Nigeria***

***Cuba***

## Other (40)

Tech Base (11)

Belgium

Bulgaria

*Czech Republic*

Finland

Hungary

Lithuania

Mexico

Netherlands

Norway

Slovakia

Spain

Other Annex 2 (8)

Austria

Bangladesh

Chile

Columbia

Others (21)

*Armenia\**

*D R of Congo*

*Denmark*

*Georgia*

*Ghana*

*Greece*

*Jamaica*

*Jordan*

*Latvia*

*Malaysia*

*Morocco*

*Myanmar*

*Philippines*

*Portugal*

*Slovenia\**

*Thailand*

*Tunisia*

*Turkey*

*Uruguay*

*Uzbekistan*

*Venezuela*

Note: ? = Public debate today over status, thus of 18 w/ weapons or suspected of seeking them now, status of 7 debated in press .

76 States w/ reactor or delivery system : Acknowledged to have, plan, or had power reactors, research reactors,

or dual capable missile systems, but does not include all states that might want to acquire nuclear weapons from others

44 Annex 2 States: CD Participants w/ reactor in 1996 whose CTBT ratification needed for Entry Into Force of CTBT

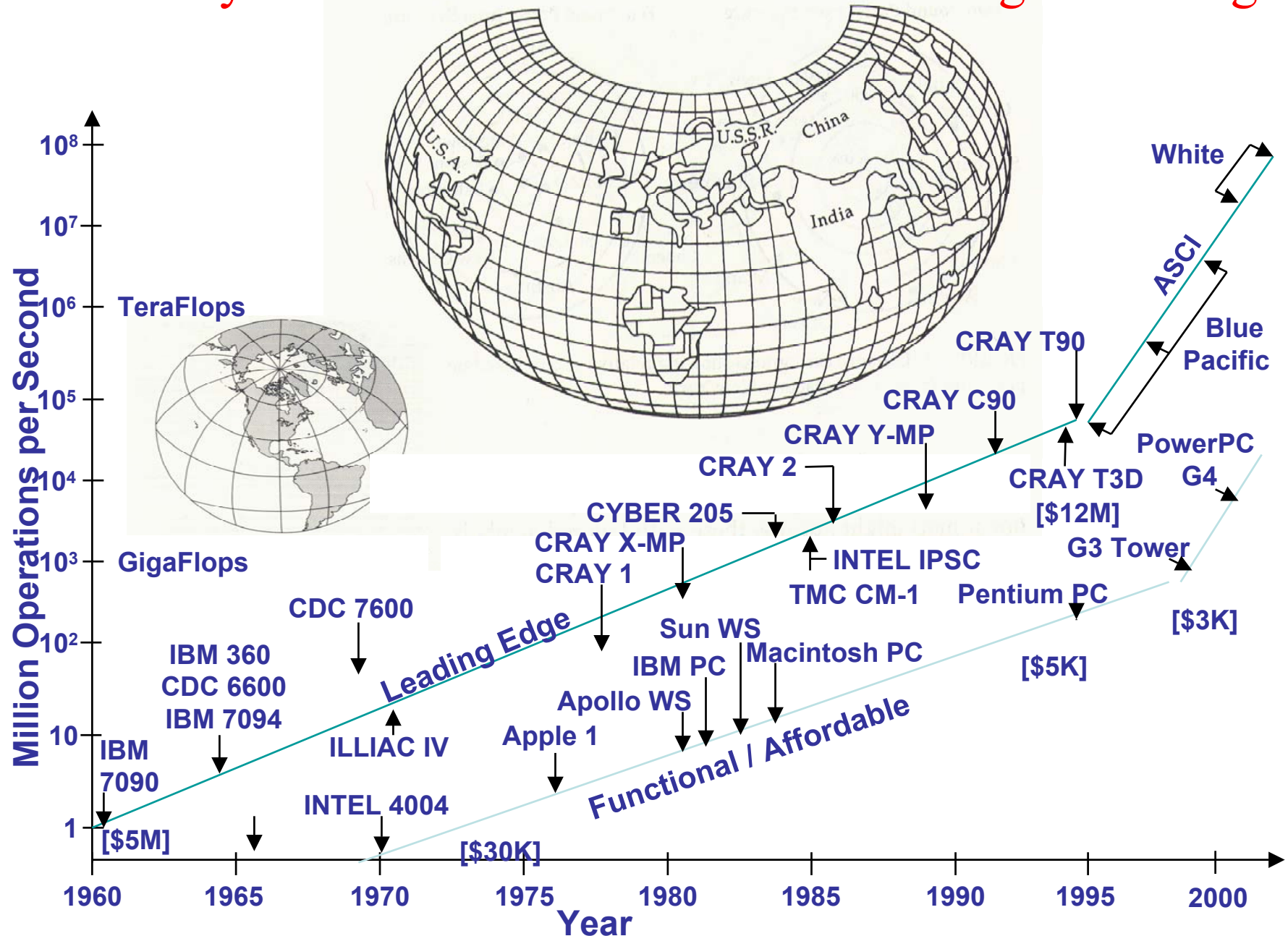
(11 Tech Base: Advanced Nuclear Science & Industry, but no public nuclear weapons history except alliance contingencies.)

32 non-Annex 2 States Other History includes World War II

[Draft for Comments Only 18 April 2003]



# Do we really understand Political and Technological Change?







Cold War?

## Where are the Priority Threats with the End of the Cold War?

Blocks (North/South, East/West)?

Alliances (Russia/China)?

Coalitions?

Nation States?

Unauthorized State Actors?

State Surrogates

Non-State Sponsored Terrorists?

Ethnic & Communal Conflict?

Affinity Groups?

Transnational Entities?

Copy Cats and Cyber Groupies?

Individuals and Small Cells?

#

CONSEQUENCES

*Risk?*

Post-Cold War?

PROBABILITY

%





**Thank You everyone, but especially CEA:**  
**Jacques Bouchard**  
**Jean-Claude Gauthier**  
**Emmanuel Tournon**  
**Mrs. Josette Aubigny**  
**Mrs. Odile Landrin**

**Our Chairs, Our Speakers, and Staff**





# Trends and/or Dynamics in Technology and Context: What have we Learned? Where are we Headed?



1953

2003

< 2053

Defense

Thermonuclear  
Sword of Damocles;  
Bi-polar Balancer

Deep Reductions;  
Weapons of Last Resort;  
Counter WMD

Regional Competition?;  
Multi-polar deterrence?  
Super-terrorism?  
Abolition?

Proliferation

Only 3 nuclear powers,  
each a permanent  
member of UN Security  
Council

188 NPT Parties; DPRK;  
9 nuclear states w/ half of  
world's population;  
4 rollback states.

Universal Latency?  
Sub- and trans- national  
actors?  
Irrelevant?

Power

Developing nuclear  
submarines

Some 500 power reactors,  
but growth diminishing

Legacy systems v. New  
designs & growth?

Applications

1st Generation Image  
Intensifiers spread real  
time X-ray imaging

Digital & Genetic  
revolutions re-energize  
Nuclear Diagnostics

Individualized medicine?  
Nano-imaging?  
Taboo?

Materials

Shortage for military  
and civilian use

Huge civilian and military  
overhang; Waste bottleneck

Regional Repositories?  
Waste Minimalization?  
Transmutation? Paralysis?

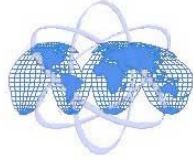
Governance,  
Benefits &  
Risk

Cold War outweighs  
environmental impact;  
Atomic Energy Act

Environmental Zero  
Tolerance; NIMBY; IAEA;  
UNSC veto threat

Universal Norms v. Like-  
minded Core v. Spheres of  
Influence? Pre-negotiated  
rules for Risk Analysis?





Significance from Security Perspective

# Alternative Nuclear Futures?

More?  
Same?  
Less?

6	8	9
3	5	7
1	2	4

Less?

Same?

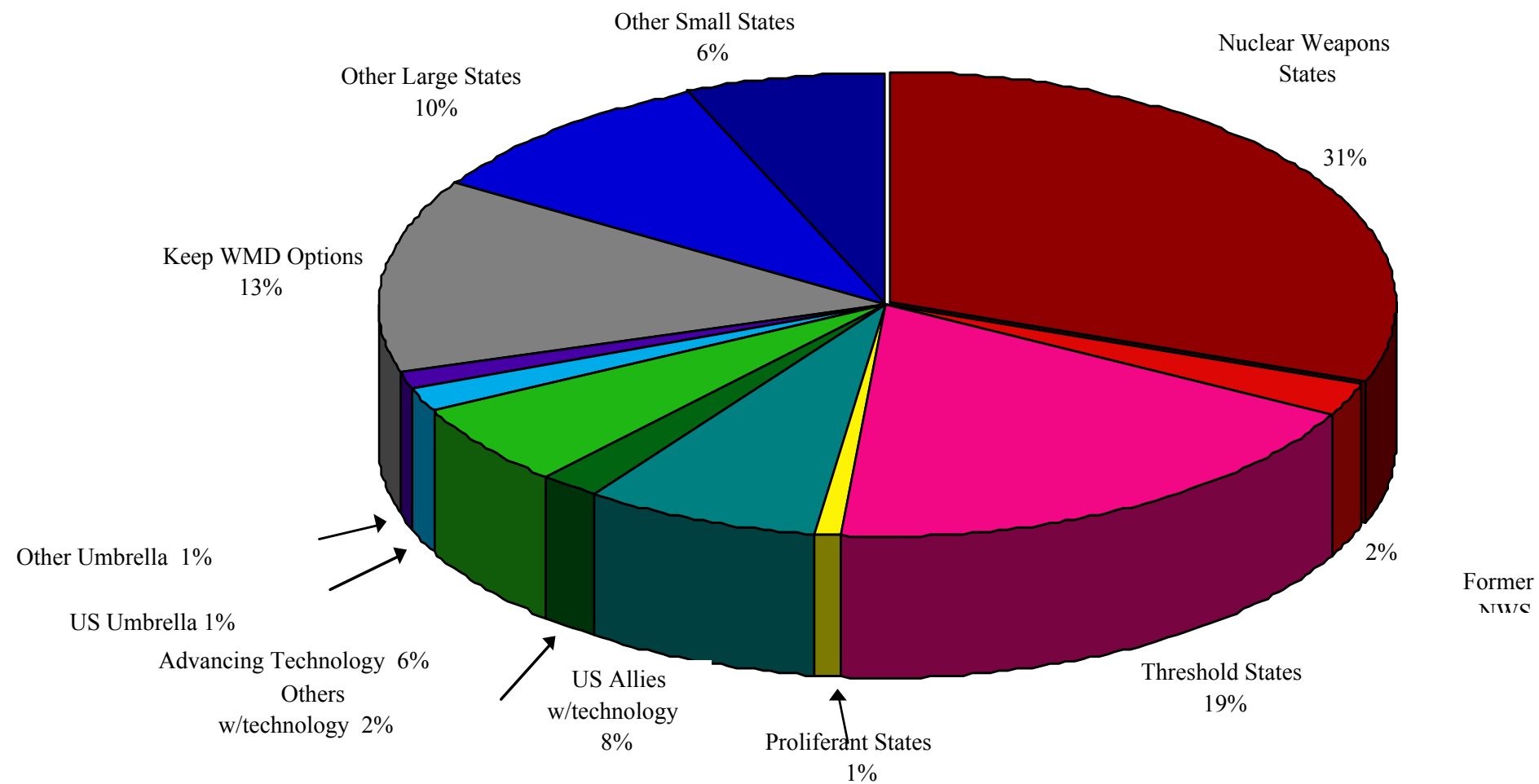
More?

Significance from Civilian Perspective?

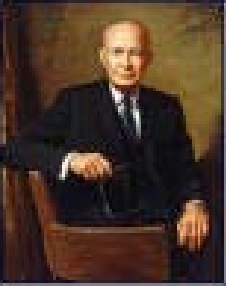




## NUCLEAR POLICY BY POPULATION





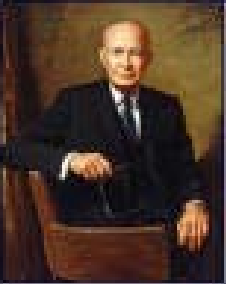


# **Straw Man:** **Alternative Nuclear Futures?** **Bulls, Bears, or Index Funds?**

**Will nuclear security issues be**

- **More Significant?**
  - **WMD Proliferation and Latency?**
  - **Asymmetric Response**
  - **Multi-polar Spheres of Influence?**
  - **Nth World Rivalry and Use?**
  - **Weapons of Alienation?**
- **About the Same?**
  - **Legacy systems and platforms?**
  - **Pace of dismantlement?**
  - **Evolutionary political change?**
- **Less Significant?**
  - **Advanced Conventional Munitions?**
  - **End of Superpower Face-off?**
  - **Deep Reductions?**
  - **Globalization?**



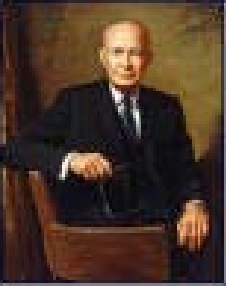


## Straw Man Factors (continued)

### Will nonproliferation accomplishments be

- **More Significant?**
  - 188 of 194 Parties to NPT?
  - Iraq and or other rollback?
  - NP support regimes (NSG, MTCR, etc)?
  - Rise of economic interests?
- **About the Same?**
  - Already most people in countries that have nukes?
  - Latent capabilities now long standing?
  - Few additional countries seek capability?
  - Very few WMD Rogues?
- **Less Significant?**
  - Technology and Talent Spread?
  - Super-terrorism and Fundamentalism?
  - Conflicts of political and economic interests?
  - Loose Nukes and Material?
  - Unraveling of NPT norms and/or enforcement?
  - Wassenaar weaker than COCOM?
  - DPRK? Failed Nuclear States?
  - Non-roguers follow Indian Model?



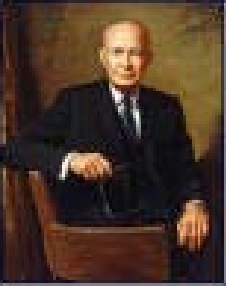


## Straw Man Factors:

### Will nuclear power be

- **More Significant?**
  - **Advanced Reactor Designs?**
  - **Proliferation-resistance enhancements?**
  - **Hydrogen Economy?**
  - **Climate Change?**
  - **New Governance and Risk Mitigation?**
  - **Yucca Mountain and Regional Repositories?**
- **About the Same?**
  - **Legacy Reactors, Waste, and Materials?**
  - **Long Lead times for Reactors?**
  - **Longer Lead times for Waste Disposal?**
  - **Persistence of Proliferators?**
  - **Permanent Bureaucracy?**
- **Less Significant?**
  - **Vulnerability to terrorism?**
  - **Globalization of NIMBY?**
  - **Rise of Renewable Energy Sources?**
  - **Tight EIS and health standards?**
  - **Opportunity Cost for Capital?**





## Straw Man Factors (continued)

### Will non-power nuclear technology be

- **More Significant?**
  - Reduced dose, precise applications?
  - Higher contrast imaging?
  - Digital databases and networked experts?
  - Artificial Intelligence adjuncts?
  - Hormesis?
- **About the Same?**
  - Sunk equipment costs with expensive alternatives?
  - Waste disposal bottleneck?
  - Established protocols, regulatory inertia?
- **Less Significant?**
  - Alternative non-nuclear imaging & diagnostics?
  - Genetic therapy and advanced biochemistry?
  - Tighter security on radioactive materials?
  - Improved modeling of materials and biological processes?



## **Special Challenges**

### **-Political Change**

- Failed States**

- Common Norm, but Different Circumstances**

### **-Economic Change**

- Opportunity Cost of Capital**

- globalization**

### **-Technological Change**

- Spread of Sensitive Technology**

- De-infrastructurization**

- Dual Use Revolution**

- Latency**

- Just in Time Inventory**

- Outsourcing**

- 1x10 to the 4th or 5th on Material**

### **-Human Behavior**

- Insider Threat**

- Alienated Age Groups**

- Ethnic Conflict**

- Religious Wars**

- Domestic Politics**

- Geo-strategic Calculations**